

# PATENT COOPERATION TREATY

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Article 12, Rules of practice 56)

(PCT Article 36 and PCT Rule 70)

Applicant's or agent's file reference: <b>16-593</b>	See Form PCT/IPEA/416 for further action.	
International application No. <b>PCT/JP2005/003129</b>	International filing date (day/month/year) <b>25. 02. 2005</b>	Priority date (day/month/year) <b>27. 02. 2004</b>
International Patent Classification (IPC) or national classification and IPC <b>Int.Cl.<sup>7</sup> F02M51/06 (2006.01)</b>		
Applicant <b>KEIHIN CORPORATION</b>		
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of <u>  3  </u> sheets including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising</p> <p style="margin-left: 20px;">a. <input checked="" type="checkbox"/> a total of <u>  5  </u> sheets (10 sheets in the English version), as follows:</p> <p style="margin-left: 40px;"><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p style="margin-left: 40px;"><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No.I and the Supplemental Box.</p> <p style="margin-left: 20px;">b. <input type="checkbox"/> a total of (indicate type and number of electronic carrier(s)) _____, containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>		
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I      Basis of the report</p> <p><input type="checkbox"/> Box No. II     Priority</p> <p><input type="checkbox"/> Box No. III    Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV    Lack of unity of the invention</p> <p><input checked="" type="checkbox"/> Box No. V      Reasoned statement under PCT Article 35(2) with regard to novelty, inventive step or industrial applicability: citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI    Certain documents cited</p> <p><input type="checkbox"/> Box No. VII   Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII   Certain observations on the international application</p>		

Date of submission of the demand <b>22. 09. 2005</b>	Date of completion of this report <b>06. 04. 2006</b>
Name and mailing address of the IPEA/JP	Authorized officer
Facsimile No.	Telephone No.

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.  
PCT/JP2005/003129

## I. Basis of the report

1. With regard to the language, this report is based on the following language.

- ☒ the language in which the international application was filed.  
☐ This report is based on translations from the original language into the following language \_\_\_\_\_, which is language of a translation furnished for the purpose of:
- ☐ international search (under Rules 12.3 and 23.1(b))
  - ☐ publication of the international application (under Rule 12.4).
  - ☐ international preliminary examination (under Rules 55.2 and/or 55.3).

2. With regard to the elements of the international application, this report is based on (replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):

- ☐ The international application as originally filed/furnished
- ☒ the description:  
pages 1, 4 to 7, 10 to 12 (1, 2, 5, 7 to 15, 17, 19 to 23 in the English version), as originally filed/furnished  
pages\* 2, 3, 8 and 9 (3, 4, 4/1, 6, 6/1, 16 and 18 in the English version), received by this Authority on  
December 26, 2005  
pages\* \_\_\_\_\_, received by this Authority on \_\_\_\_\_
- ☒ the claims:  
No. 3, as originally filed/furnished  
Nos.\* \_\_\_\_\_, as amended (together with any statement) under Article 19  
Nos.\* 1 and 2, received by this Authority on December 26, 2005  
Nos.\* \_\_\_\_\_, received by this Authority on \_\_\_\_\_
- ☒ the drawings:  
pages/figs. 1 to 4, as originally filed/furnished  
pages/figs.\* \_\_\_\_\_, received by this Authority on \_\_\_\_\_  
pages/figs.\* \_\_\_\_\_, received by this Authority on \_\_\_\_\_
- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages \_\_\_\_\_
- ☐ the claims, No. \_\_\_\_\_
- ☐ the drawings, sheets/fig \_\_\_\_\_
- ☐ the sequence listing (specify): \_\_\_\_\_
- ☐ any table(s) related to sequence listing (specify): \_\_\_\_\_

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c))

- ☐ the description, pages \_\_\_\_\_
- ☐ the claims, Nos. \_\_\_\_\_
- ☐ the drawings, sheets/fig \_\_\_\_\_
- ☐ the sequence listing (specify): \_\_\_\_\_
- ☐ any table(s) related to sequence listing (specify): \_\_\_\_\_

\* If item 4 applies, some or all of those sheets may be marked "superseded."

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.  
PCT/JP2005/003129

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

## 1. Statement

Novelty (N)	Claims 1 to 3	Yes
	Claims	No
Inventive step (IS)	Claims 1 to 3	Yes
	Claims	No
Industrial applicability (IA)	Claims 1 to 3	Yes
	Claim	No

## 2. Citations and explanations (PCT Rule 70.7)

It appears that the invention according to Claims 1 to 3 is neither described in any of the documents cited in the ISR nor obvious for a person skilled in the art.

A fuel injection valve in the invention described in Document 1 cited in the ISR: JP 7-279794 A (Toyota Motor Corp.) includes a "groove 10", however, the "groove 10" is formed in a "core 1" but not formed in a non-magnetic member.

On the other hand, a fuel injection valve in the invention according to Claims 1 to 3 can prevent the accumulation and deposition of the chips etc. in an annular recess (44), since the annular recess (44) is formed in an inner peripheral surface of a non-magnetic cylinder (26).

[0004] The present invention has been accomplished with such circumstances in view, and it is a first object of the present invention to provide an electromagnetic fuel injection valve, wherein the area of the opposed faces of the stationary core and the movable core can be set at a large value to the utmost and moreover, it is possible to prevent the accumulation and deposition of the chips and the magnetic powder. It is a second object of the present invention to provide a producing process suitable for producing such an electromagnetic fuel injection valve.

#### MEANS FOR SOLUTION OF PROBLEMS

[0005] To achieve the above first object, according to a first aspect of the present invention, there is provided an electromagnetic fuel injection valve, in which a valve member is contained in a valve housing comprising a magnetic cylinder coaxially coupled at a front end thereof to a valve seat member having a valve seat, the valve member being spring-biased in a direction in which the valve member is seated on the valve seat; a non-magnetic cylinder serving as a member different from the magnetic cylinder is coaxially coupled at a front end thereof to a rear end of the magnetic cylinder to surround a portion of a movable core which is coaxially connected to the valve member with a rear end face thereof serving as a movable attraction face; and a front portion of a stationary core having a front end face serving as a stationary attraction face is fitted into and fixed in a rear portion of the non-magnetic

cylinder, so that the stationary attraction face is opposed to the movable attraction face, characterized in that the front portion of the stationary core is fitted and fixed in the non-magnetic cylinder so as to be in close contact with an inner surface of an intermediate portion of the non-magnetic cylinder in a region corresponding to the stationary attraction face, and in the inner peripheral surface of the non-magnetic cylinder, an annular recess having a flat portion flush connected to the stationary attraction face is provided to form an annular chamber between the annular recess and an outer periphery of the rear portion of the movable core, and in the inner peripheral surface of said non-magnetic cylinder, a center bore having an inside diameter larger than an outside diameter of the stationary attraction face is further provided at a location in front of the annular recess, a guide bore is provided in an inner periphery of the magnetic cylinder and flush connected to the center bore of the non-magnetic cylinder, and the annular chamber is formed by continuously connecting the flat portion of said annular recess and the center bore and guide bore by means of an inclined surface.

[0006] According to a second aspect of the present invention, in addition to the arrangement of the first aspect, a guide portion is integrally provided on the movable core having at a rear end face thereof the movable attraction face having an outside diameter substantially equal to that of the stationary attraction face to overhang sideways from the outer periphery

of the movable attraction face, so that the guide portion is slidably fitted in the guide bore.

[0007] To achieve the above second object, according to a third aspect of the present invention, there is provided a process  
5 for producing an electromagnetic fuel injection valve according

to provide an increase in attraction force. In addition, an annular groove cannot be formed between the stationary core and the non-magnetic cylinder, and the annular chamber is defined between the movable core and the non-magnetic cylinder to surround the outer periphery of the rear portion of the movable core. Therefore, even if chips and a magnetic powder are produced, they can be fluidized and thus, can be prevented from being accumulated and deposited. More specifically, the annular recess forming the annular chamber between the rear outer periphery of the movable core and the annular recess is to be formed at the inner peripheral surface of the non-magnetic cylinder serving as a member different from the magnetic cylinder, and therefore, even if the annular recess is formed, the magnetic characteristic of the structure surrounding this annular recess is not changed. Further, the annular recess is formed to have a flat portion flush connected to the stationary attraction face of the stationary core, and the center bore having an inside diameter larger than an outside diameter of the stationary attraction face is provided in an inner periphery of the non-magnetic cylinder at a location in front of the annular recess, and on the other hand, the guide bore is provided in the inner periphery of the magnetic cylinder coaxially connected at the front end and the rear end of the non-magnetic cylinder and is flush connected to the center bore of the non-magnetic cylinder, and the annular chamber is formed by continuously connecting the flat portion of the annular recess and the center

bore and guide bore by means of an inclined surface. Therefore, the above-described chips and magnetic powder are fluidized on smooth continuous surfaces including the inclined surface of the annular recess formed in the non-magnetic cylinder and  
5 can extremely effectively be prevented from being accumulated and deposited there.

[0009] With the second feature of the present invention, an attraction force can be further increased by setting the outside  
( ) diameter of the movable attraction face at a value substantially  
10 equal to that of the stationary attraction face. Moreover, the movable core is guided in the guide bore in the magnetic cylinder and hence, it is possible to provide an enhancement in attraction responsiveness.

[0010] With the third feature of the present invention, when  
15 the front portion of the stationary core blank is fitted into and fixed in the non-magnetic cylinder blank, an operation of fitting and fixing the stationary core blank in the non-magnetic cylinder blank is easy, because the stationary core blank has the chamfer around its outer periphery at its front end.  
20 Moreover, the stationary attraction face, the annular recess, the center bore and the guide bore are formed by the grinding of the stationary core blank, the non-magnetic cylinder blank and the magnetic cylinder blank, and hence, a dust such as chips produced by the fitting and the chamfer can be removed by the

and the non-magnetic cylinder blank 26' is formed into the cylindrical shape having the inner periphery increased in diameter at the three stages in the rearward direction.

[0034] After the coupling of the stationary core blank 22',

5 the non-magnetic cylinder blank 26' and the magnetic cylinder blank 9' as described above, the front portion of the smaller-diameter tube portion 22a' of the stationary core blank 22' is ground to remove the chamfer 48, whereby a flat stationary attraction face 42 is formed, and the inner peripheries of the  
( )  
10 non-magnetic cylinder blank 26' and the magnetic cylinder blank 9' are subjected to a grinding treatment, whereby an annular recess 44, a center bore 46 and a guide bore 17 are formed.

[0035] Referring again to Fig. 2, the recess 50 having the annular step 49 facing rearwards at its inner end is provided in the  
15 inner periphery of the rear portion of the movable core 18, and the ring-shaped stopper 28 is press-fitted into the recess 50 in such a manner that its front end abuts against the step 49. A flat abutment face 51 is disposed at a location displaced  
( )  
20 end of the movable core 18 toward the stationary attraction face 42, and is formed to be able to abut against the stationary attraction face 42 at the rear end of the stopper 28. A slant 52 is formed in a tapered shape or an arcuate shape on the inner periphery of the rear end of the movable core 18 and the outer  
25 periphery of the rear end of the stopper 28 to connect continuously and smoothly the movable attraction face 41 and the abutment

press-fitting the stopper blank 28' into the smaller-diameter bore 50' in the rear portion of the movable core blank 18' is easy, because the rear end of the smaller-diameter bore 50' is connected to the larger-diameter bore 53 opening into the rear end of the movable core blank 18' through the tapered step 54, and the chamfer 55 is provided around the outer periphery of the front end of the stopper blank 28'.

[0039] After press-fitting of the stopper blank 28' into the rear portion of the movable core blank 18', the rear ends of the stopper blank 28' and the movable core blank 18' are ground, whereby a movable attraction face 41, an abutment face 51 and a slant 52 are formed. In addition, the rear portion of the stopper blank 28' and the rear portion of the movable core blank 18' are cut off, and the recess 50 is formed by a portion of the smaller-diameter bore 50'.

[0040] Next, the operation of this embodiment will be described below. The front portion of the stationary core 22 is fitted and fixed in the non-magnetic cylinder 26 in such a manner that it is in close contact with the inner surface of the intermediate portion of the non-magnetic cylinder 26 in the region corresponding to the stationary attraction face 42, and the annular recess 44 having the flat portion 44a flush connected to the stationary attraction face 42 is provided in the inner surface of the non-magnetic cylinder 26, so that the annular chamber 45 is defined between the annular recess 44 and the outer periphery of the rear portion of the movable core 18.

## CLAIMS

[1] (amended) An electromagnetic fuel injection valve, in which a valve member (20) is contained in a valve housing (8) comprising a magnetic cylinder (9) coaxially coupled at a front end thereof to a valve seat member (10) having a valve seat (13), said valve member (20) being spring-biased in a direction in which said valve member (20) is seated on said valve seat (13); a non-magnetic cylinder (26) serving as a member different from said magnetic cylinder (9) is coaxially coupled at a front end thereof to a rear end of the magnetic cylinder (9) to surround a portion of a movable core (18) which is coaxially connected to said valve member (20) with a rear end face thereof serving as a movable attraction face (41); and a front portion of a stationary core (22) having a front end face serving as a stationary attraction face (42) is fitted into and fixed in a rear portion of said non-magnetic cylinder (26), so that said stationary attraction face (42) is opposed to said movable attraction face (41), characterized in that the front portion of said stationary core (22) is fitted and fixed in said non-magnetic cylinder (26) so as to be in close contact with an inner surface of an intermediate portion of said non-magnetic cylinder (26) in a region corresponding to said stationary attraction face (42), and in the inner peripheral surface of said non-magnetic cylinder (26), an annular recess (44) having a flat portion (44a) flush connected to said stationary attraction face (42) is provided to form an annular chamber (45) between said annular recess

(44) and an outer periphery of the rear portion of said movable core (18), and in the inner peripheral surface of said non-magnetic cylinder (26), a center bore (46) having an inside diameter larger than an outside diameter of said stationary attraction face (42) is further provided at a location in front of said annular recess (44), a guide bore (17) is provided in an inner periphery of said magnetic cylinder (9) and flush connected to said center bore (46) of the non-magnetic cylinder (26), and said annular chamber (45) is formed by continuously connecting said flat portion (44a) of said annular recess (44) and said center bore (46) and guide bore (17) by means of an inclined surface.

[2] (amended) An electromagnetic fuel injection valve according to claim 1, wherein a guide portion (47) is integrally provided on said movable core (18) having at a rear end face thereof said movable attraction face (41) having an outside diameter substantially equal to that of said stationary attraction face (42) to overhang sideways from the outer periphery of said movable attraction face (41), so that said guide portion (47) is slidably fitted in said guide bore (17).

[3] A process for producing an electromagnetic fuel injection valve according to claim 1, comprising a step of preparing a cylindrical magnetic cylinder blank (9') and a non-magnetic cylinder blank (26') for forming said magnetic cylinder (9) and said non-magnetic cylinder (26), respectively, as well as a stationary core blank (22') having a chamfer (48) around the

outer periphery at a front end thereof for forming said stationary core (22); a step of fixing said stationary core blank (22') to said non-magnetic cylinder blank (26') in a state in which a front portion of said stationary core blank (22') has been  
5 fitted so as to be in close contact with an inner surface of an intermediate portion of said non-magnetic cylinder blank (26') coaxially coupled to said magnetic cylinder blank (9'); and a step of grinding the front portion of said stationary  
core blank (22') so as to remove said chamfer (48), thereby  
10 forming a flat stationary attraction face (42), and subjecting inner peripheries of said non-magnetic cylinder blank (26') and said magnetic cylinder blank (9') to a grinding to form said annular recess (44), said center bore (46) and said guide bore (14), the above steps being carried out sequentially.